Remarks

Further and favorable reconsideration is respectfully requested in view of the foregoing amendments and following remarks.

Initially, the cross reference to the parent application, previously inserted by Preliminary Amendment, has been amended to indicate the abandoned status of the parent application.

Each of claims 9 and 10, which are the only claims under consideration, has been amended to limit component (B) to niobium and/or tantalum, and also to limit (C) to rhodium or a mixture of rhodium and iridium.

New claims 15 and 16 have been added to the application. Claim 15 is supported by page 5, line 14 of the specification, and claim 16 is supported by page 6, lines 1-4.

The patentability of the presently claimed invention, as set forth in amended claims 9 and 10 above, over the disclosures of the references relied upon by the Examiner in rejecting the claims will be apparent upon consideration of the following remarks.

Thus, the rejection of claim 9 under 35 U.S.C. §102(b) or 35 U.S.C. §103(a) based on Gu et al. 1998, as well as the rejection of claim 10 under 35 U.S.C. §103(a) as being obvious over Gu et al. 1998 in view of Duhl et al. or Bradley, and the rejection of claims 9 and 10 under 35 U.S.C. §103(a) as being unpatentable over Koizumi et al., are respectfully traversed.

It is Applicants' position that none of these references disclose or suggest the subject matter of amended claims 9 and 10 as set forth above, particularly because of the limitation in claims 9 and 10 that component (C) must include rhodium.

Furthermore, with regard to the Koizumi et al. reference, Applicants note that this reference corresponds to Japanese Patent Laid-Open No. 311584/1996, which is cited at the top of page 3 of the present specification.

As the Examiner has noted, the Koizumi et al. reference teaches that nickel can be added to the alloy. More specifically, Koizumi et al. indicates that partial substitution of iridium or rhodium with such an element as is inexpensive and has light weight, for example, nickel or cobalt, may make some contribution to reduction of price and specific gravity of the refractory superalloys. Column 2, lines 49-52.

However, the present invention achieves a good balance of high-temperature strength and ductility in the alloys, and this is achieved not only by controlling the amounts of the components in the alloys, but also by the fact that the alloy has a two-phase structure in which a $L1_2$ phase is precipitated in a matrix of a fcc phase (and the amount of the $L1_2$ phase is from 20 to 80 % by volume).

In this regard, the phase structure (crystalline structure phase) of an alloy is determined by the composition of the alloy. The phase structure easily changes with the kinds and quantities of elements to be added to the alloy. The present inventors investigated the characteristics of alloys in which nickel was added at various rates to the alloy of the Koizumi et al. reference. They found that the composition range of good strength and ductility balance for (a) a Ir-Nb-Ni system alloy and (b) a Rh-Nb-Ni system alloy are as shown by the shaded areas in attached Figs. 1(a) and 1(b), respectively.

Furthermore, the composition range of attached Fig. 1 can be essentially expressed as an overlapping range of the fcc + $L1_2$ phase structure range in attached Fig. 2(a) or (b), and the composition range of attached Fig. 2(c). Fig. 2(a) and (b) show the phase diagram for (a) a Ir-Nb-Ni system alloy and (b) a Rh-Nb-Ni system alloy, respectively. Fig. 2(c) shows the composition range of 30 - 75 atomic % Ir, Rh ___ 5 - 20 atomic % Nb __ 5 - 65 atomic % Ni alloys.

In considering attached Fig. 1, it is necessary to ensure that the amount of Ni is 5% or more in order to achieve an improvement in ductility of the alloy of (a) a Ir-Nb-Ni system, and an improvement in strength of the alloy of (b) a Rh-Nb-Ni system. Therefore, the minimum amount of Ni in Fig. 2(c) is set at 5%.

Also with regard to Fig. 1, in (a) the Ir-Nb-Ni system, ductility is improved in the range where the amount of Ir is up to 80%. However, in (b) the Rh-Nb-Ni system, strength decreases remarkably when the amount of Rh exceeds 75%. Therefore, the maximum amount of Ir + Rh in Fig. 2(c) is set at 75%.

Claim 9 is directed to an Ir, Rh-Nb-Ni system alloy expressed by an overlapping range of the fcc + $L1_2$ phase structure range (the shaded areas) in Fig. 2(a) or (b), and the corresponding composition range of Fig. 2(c). This alloy of claim 9 provides an excellent balance of strength and ductility. The same is true for the alloy of claim 10.

Applicants also note that it is not merely a case of ensuring that the amount of nickel in the alloy falls within the range of 5 - 65 atomic % as recited in claims 9 and10. Rather, the alloy must also have a two-phase structure in which a $L1_2$ phase is precipitated in a matrix of a fcc phase, and the amount of the $L1_2$ phase must also be 20 - 80% by volume.

For instance, referring to Example 1 beginning on page 14 of the present specification, all of Superalloys A-D contain the same components, including varying amounts of nickel, more specifically 10, 20, 30 and 50 atomic % of nickel. However, as indicated by the first paragraph on page 15, only Superalloys A and B have the two-phase structure, namely the fcc phase and the $L1_2$ phase. Superalloys C and D, in addition to the fcc phase and $L1_2$, also have a third phase, namely a δ phase belonging to an orthorhombic system. The properties of alloys A-D are discussed in the first two paragraphs on page 16, referring to Fig. 2 of the drawings filed with the application. It is apparent from this discussion that having an alloy with the claimed amount of nickel is not sufficient to achieve a good balance of strength and ductility unless the alloy also has the two-phase structure.

As indicated above, the only discussion of nickel in the Koizumi et al. reference is one of advising the art-skilled that substituting nickel for part of the iridium or rhodium will be effective to reduce the price and specific gravity of the alloy. This disclosure fails to suggest the alloys of the present invention which have a two-phase structure in which a $L1_2$ phase is precipitated in a matrix of a fcc phase, and the amount of the $L1_2$ phase is 20 - 80 % by volume. As indicated above, such a two-phase structure is not achieved merely by designing the alloy to contain components within the presently claimed ranges, i.e. not all alloys having components within the presently claimed ranges will have the required two-phase structure, as shown by the attached phase diagrams.

For these additional reasons, Applicants take the position that the presently claimed invention is clearly patentable over the Koizumi et al. reference.

The rejection of claim 9 under 35 U.S.C. §102(a) or 35 U.S.C. §103(a) based on Gu et al. 1999, as well as the rejection of claim 10 under 35 U.S.C. §103(a) as obvious over Gu et al. 1999 in view of Duhl or Bradley, are respectfully traversed.

As the Examiner has noticed, the Gu et al. 1999 reference can be overcome by obtaining the benefit of Applicants' Japanese priority date, which is February 2, 1999, prior to the October 1999 publication date of the Gu et al. reference. For this purpose, Applicants are enclosing a copy of a certified copy of the Japanese priority application, together with an English translation thereof. [A certified copy of the Japanese priority application, together with a verified English translation, will be filed in the near future.] In view of these documents, Applicants take the position that the Gu et al. 1999 reference is not available as prior art against the present invention.

For these reasons, Applicants submit that the presently claimed invention as set forth in amended claims 9 and 10 is clearly patentable over the applied references.

Attention is also directed to new claims 15 and 16, which recite additional limitations. It is Applicants' position that the subject matter of these claims is also not disclosed or suggested by the applied references.

Applicants also note that the European application corresponding to the present U.S. application has been allowed, as EP 1 026 269, a copy of which is enclosed.

Therefore, in view of the foregoing amendments and remarks, it is submitted that each of the grounds of rejection set forth by the Examiner has been overcome, and that the application is in condition for allowance. Such allowance is solicited.

Respectfully submitted,

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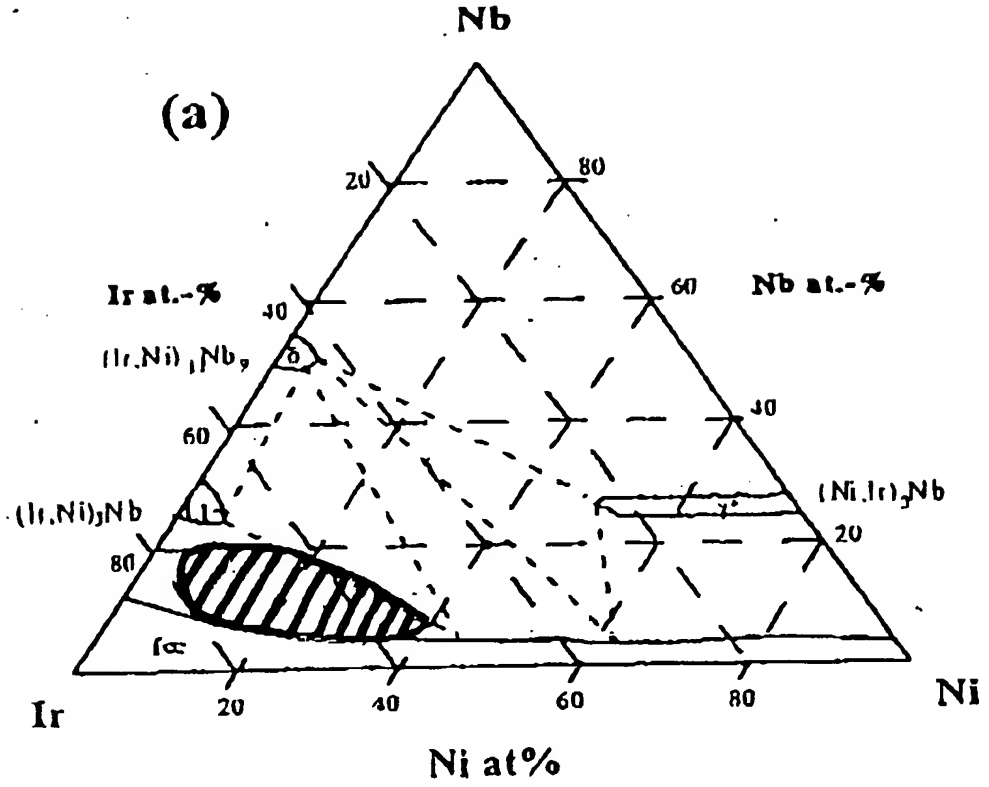
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Nb at.-%
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Ni at%
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60
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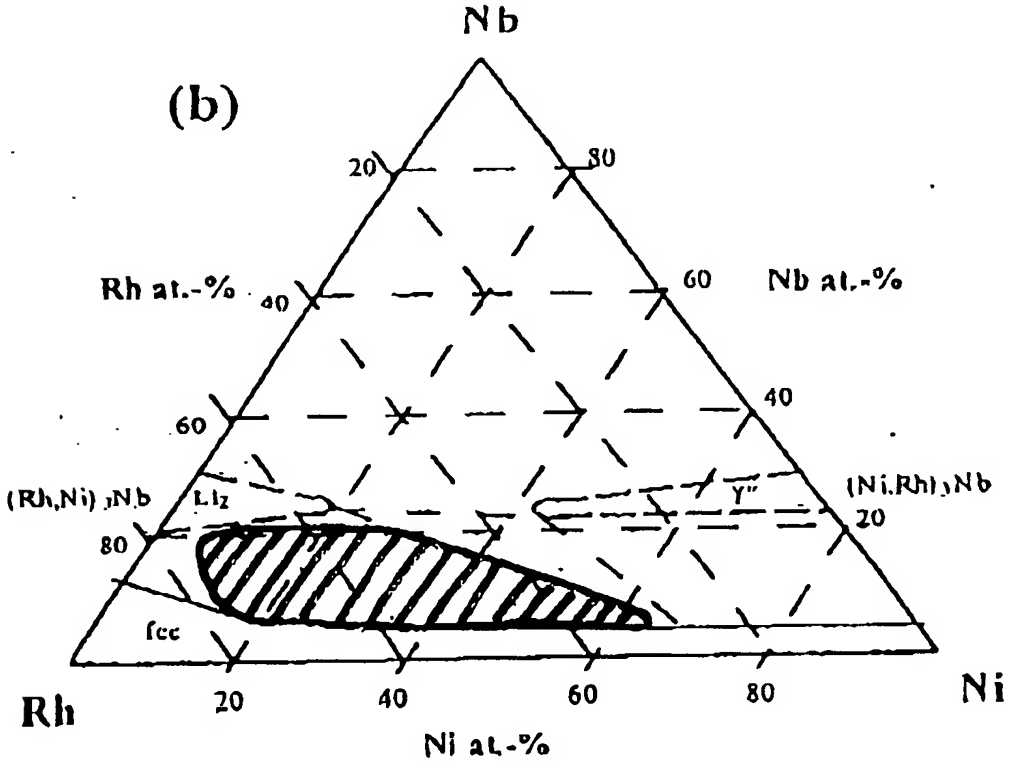
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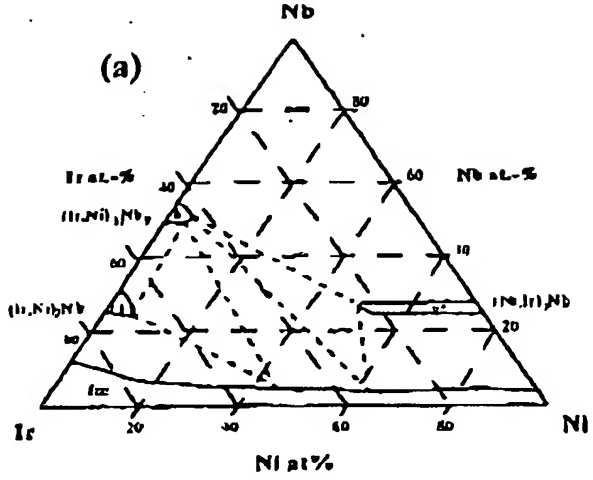
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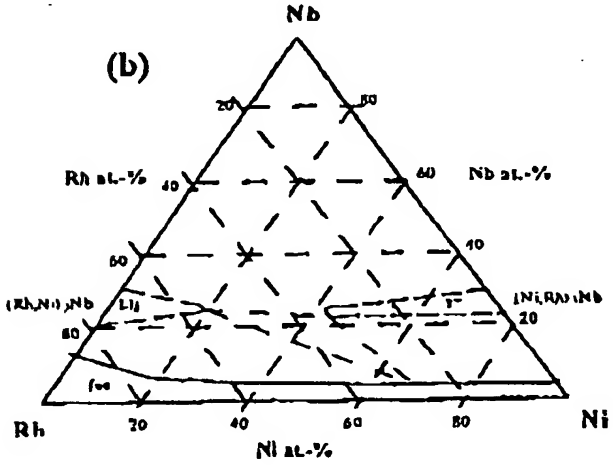
Ir
Ni
Ni at%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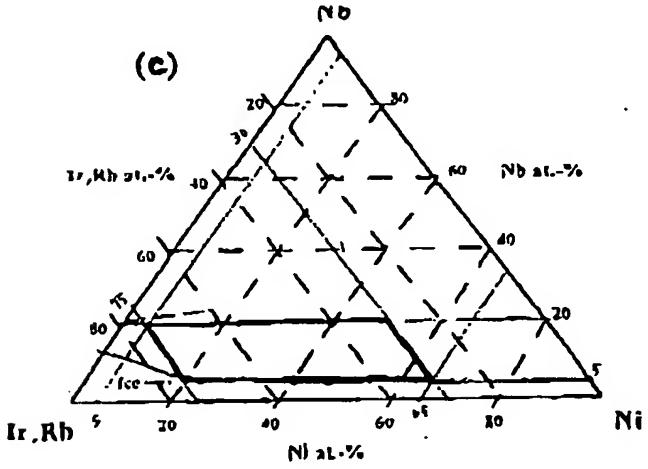
Rh
Ni
Ni at.-%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Ni
Ni at.-%